per annum, or very nearly $3,000,000 for each day in the year. The regular expenditure of more than 90 per cent of this vast sum stimulates other industries, and in this manner the volume of general business is increased in progressive ratio.

In these calculations no account has been taken of the large number of people forming the proprietary interest of this vast aggregation of capital, which comprises people in all classes and in all occupations, and scattered throughout all parts of the country.

The New York Central Railroad Company has 10,000 stockholders, whose average holding is about $9,000. If we take that sum as representing the average holding of all stock and bondholders in the country, the total number of such would be over 1,000,000, representing more than 5,000,000 persons with important interests in the success of the railroad system.

From these deductions a general idea can be gathered of the magnitude of the railroad interest, and how vast and widespread is the interest of our people in that system.

From the tables in the Manual it appears that during the past ten years the following percentages of profit have been distributed to holders of the share capital of our railroads. In 1879 the dividends paid averaged 2.5 per cent of the total amount of capital stock outstanding; in 1880, 2.8 per cent was paid; in 1881, 2.9 per cent; in 1882, 2.91 per cent; in 1883, 2.75 per cent; in 1884, 2.48 per cent; in 1885, 2.02 per cent; in 1886, 2.04 per cent; in 1887, 2.18 per cent; and in 1888, 1.77 per cent.

BUHACH.

IN an article on the California insecticide known as buhach, which was mentioned in *Science* of May 24, the *Journal of the Society of Arts*, London, says this product is a fine powder made from the flowers of the *Pyrethrum cinerariæfolium*, largely used for the destruction of insects. This plant was originally a native of Persia, from whence it was introduced to Dalmatia and adjoining States of Herzegovina and Montenegro, where it has been almost exclusively cultivated until a few years ago. The importance of this industry was considered so great in these countries that special efforts were made to prevent the export of seeds and plants by the governments. The plant was first introduced into California about twelve years ago by a Mr. Mileo, a native of Dalmatia, who succeeded, after some trouble, in obtaining seed from his country. After experimenting for some time, in order to find a suitable soil and climate, this gentleman finally succeeded in growing the plant on an extensive scale, and in 1880, associating himself with other capitalists, established the Buhach Producing and Manufacturing Company. At the present time the company have about 300 acres of this plant under cultivation at their farm near Atwater, Cal., and own mills for grinding the dried flowers to powder at Stockton. The cultivation of pyrethrum requires careful and intelligent supervision, and it cannot be grown successfully without irrigation. It requires three years from the time of sowing to grow plants capable of producing a paying crop of flowers, and then they will bear from four to five years longer. It is at its prime, however, in its fourth or fifth year. The plant grows about thirty inches high, and is set out in rows four feet apart, and from fifteen to twenty-four inches apart in the rows. The flowers are harvested towards the latter part of May. The stalks are cut just above the roots, and the flowers stripped from them by passing the plants through a kind of comb. The detached flowers fall into a box below, and are carried to the drying ground, where they are spread on sheets and exposed to the rays of the sun during the day, being repeatedly turned over in the meantime. They are covered during the night to prevent their absorbing moisture, as the perfect drying of the flowers is most important in order to retain the volatile oil which gives the powder its insecticide properties. It is also very necessary that this operation should be done quickly, and that the flowers during the drying process should be protected from moisture. A slight dew falling upon the flowers at this time will injure their color, and reduce their strength as an insect destroyer. In this respect the California-grown flowers are better cured, and, consequently, more valuable than those produced in Dalmatia, it being acknowledged by experts that the particular conditions of soil and climate in California are extremely favorable to the growth and curing of plants rich in the essential oil which renders them so destructive to insect life. Like many other products, insect powders are liable to adulteration, and last year a large quantity made from the flowers of the Hungarian daisy, mixed with a small proportion of pyrethrum, was placed upon the market by unscrupulous dealers. Inferior powders are also manufactured from the stems and leaves of the plant, which possess, to a certain extent, the properties of buhach.

SAWING STONE BY HELICOIDAL WIRE CORD.

A NEW plan of cutting stone by means of wire cord has been adopted in many European quarries. While retaining sand as the cutting agent, M. Panlin Gay, of Marseilles, has succeeded in applying it by mechanical means, and as continuously as the sand blast and band-saw, with both of which appliances his system — that of the "helicoidal wire cord" — has considerable analogy.

An engine puts in motion a continuous wire cord (varying from five to seven thirty-seconds of an inch in diameter, according to the work), composed of three mild steel wires twisted at a certain pitch, that found to give the best results in practice, at a speed of from fifteen to seventeen feet per second, the higher speed being adopted for the smaller diameter.

Instead of the stone being brought to the saw, the wire cord, which may be of indefinite length, is led to the stone, being guided by grooved pulleys, mounted on bearings with universal joint, which permits of their adapting themselves to any change of direction. The same cord, which is kept at uniform tension by a weighted truck on an inclined plane, may act upon any number of blocks, provided sufficient space be given between them to allow for cooling.

The pulleys are mounted in standards, and are fed down by endless screws rotated automatically if the stone be uniform, but preferably by hand if there is reason to suspect irregularities in its texture. Sand and water is allowed to flow freely into the cuts, the sand carried along by the cord in the spiral interstices between the wires causing a uniform attrition of the stone. The twist of the cord causes it, while travelling, to turn upon itself, and thus become worn evenly. A cord of 150 yards in length will cut about seventy feet deep in blocks fifteen feet long, or produce four hundred and ninety square feet of sawn surface before being worn out.

The sand must be sharp, and not used more than three times. The nature of the sand is determined by the hardness of the stone; thus, quartz sand will cut granite and porphyry, which it has hitherto been found impossible to saw, or indeed cut in any other way than by pick or chisel. An hourly advance of one inch in granite or porphyry and four inches in marble, is regularly obtained in blocks of fifteen or sixteen feet long. At the Brussels Exhibition of last year, where the system was awarded a prize, the same cord which cut marble also cut a block of concrete composed of quartz pebbles.

Not merely does the helicoidal cord saw blocks of stone, but it even cuts them out of the solid rock in the quarry. To do this, it is necessary to sink shafts of two or two and a half feet in diameter, in order to introduce the pulley-carriers. If there is a free side to start from one shaft is sufficient for a triangular block; but for a quadrangular one, which is preferable, two shafts are necessary. They are bored by a mechanical perforator, consisting of a hollow plate-iron cylinder, having at its lower end a slightly thicker collar which acts with sand and water in its latest development. The cylinder is made to revolve, at a speed of one hundred and forty revolutions a minute, by means of a tele-dynamic cable, advancing about an inch per hour in marble. An annular space is cut in the rock, leaving a core, which may be utilized as a column. The diameter of the shaftway depends upon the diameter of columns most in demand, provided a sufficient number be sunk, and the intervening angles broken down, so as to afford sufficient room for the pulley carrier.

In the case of stratified rocks, the shaft-cuts are carried down to a natural parting; but in unstratified rocks a nearly horizontal cut may be made with the cord, sufficient inclination being given to insure the flow of sand and water to the bottom of the cut.

Such is the method of working practised at the Traigneaux

Quarry, near Philippeville, in Belgium, where fifteen thousand cubic feet of marble are extracted yearly with a thirty horse-power engine, and only thirty hands in summer and twenty in winter, besides the lads who tend the wire-cords. The system is also employed at granite and marble quarries in France, Germany, Spain, Italy, Algeria, Tunis, and other countries, where it is said to be giving satisfactory and economical results.

SEWAGE PURIFICATION.

A NEW process for the purification of sewage, under patents granted to the firm of Jagger, Son, & Turley, of Halifax, England, was recently experimented with at the corporation sewage works of that city. The apparatus employed is described as follows. A carbon filtering medium is obtained by reducing to a carbonized state dry ashpit refuse which contains a large proportion of animal and vegetable matter. The refuse is placed in a carbonizer, where it is allowed to remain until the whole mass is charred by a process of slow combustion. After the carbonized material is withdrawn from the carbonizer, it is sifted by means of a circular riddle; and the cinders and a small percentage of clinkers are laid on one side for use in forming the bottom layers of the filters. The finer grades given out by the riddle, composed principally of charcoal and a small percentage of ashes, are placed as an upper layer of a shallow filter bed, about four inches in thickness.

A small carbonizer has been erected at Halifax, and a filter of 102 superficial yards laid down. The filter is two and a half feet deep, it has a six-inch concrete bottom, and brickwork sides joined in cement. The filter is divided by a fourteen-inch wall, underneath which is laid a channel for conveying away the effluent. The bottom course of brickwork of the central wall is open jointed to allow the effluent to pass from the layers of cinders to the channel. The filter bed is formed as follows. At the bottom is placed a six-inch layer of rough material, which may be clinker or broken bricks or stone. Above this layer is placed another composed of one-inch cinders laid three inches thick; then follows a layer three inches thick of quarter-inch cinders, and finally a layer of carbon four inches thick, giving a total thickness of sixteen inches. The filter is worked with a six-inch head of sewage. The sewage is conducted to the filter by a six-inch pipe, having branches, the pipe being laid on the top of the central wall. Under each branch is placed a floating splash-board, which prevents the sewage washing a hole through the filtering material. The sewage flows over and through the carbon. The effluent is clear, inodorous, and colorless, and has been proved by analysis to be very pure. The organic matter in suspension was 417.2 grains per gallon in sewage, and 1.12 grains per gallon in effluent. The albumenoid ammonia in solution was also reduced from 0.280 grains per gallon in sewage to 0.007 grains per gallon effluent.

The manner of dealing with the sewage is as follows. Across the outfall sewer are placed a series of wire-work baskets filled with cinders of different grades, to arrest the grosser floating solids. The sewage then flows to the filter-bed, where the purification of the sewage is accomplished. No chemicals whatever are used. The filter-beds will work at a rate of from 240 to 300 gallons per superficial yard per day, according to the density of sewage treated. An acre of filtering surface will be ample for dealing with the sewage from 30,000 persons, or say, 1,000,000 gallons per day. The land required for this process is only one two-hundredth part of that required for broad irrigation, or one-fortieth that required for combined precipitation and filtration. The capital cost for this process will be about $340 per thousand inhabitants up to a population of fifty thousand, and the annual working expenses for collecting and disposing of refuse and purifying sewage, inclusive of interest on capital and royalty fees, about sixteen cents per head of population.

This process solves the sludge difficulty. No chemicals being used, no weight is added to the solids in the sewage; the grosser solids are arrested in the cinder baskets, and the finer solids are deposited on the top of the filters in the form of a thin skin After a filter has worked for twenty-four hours, the flow into that particular filter is stopped, the moisture allowed to drain off, and the deposit removed by a scum plow, a little fresh carbon is laid, and the filter is then again ready for work. By a simple mechanical contrivance, a filter of one hundred yards can be cleansed and re-charged in ten minutes. The average weight of sludge made per million gallons of sewage treated by chemicals is twenty tons. In place of a semi-fluid, offensive sludge, by this carbonized refuse process, there remains a manure uninjured by chemicals, which can be carted away as it is removed from the filters, and which will equal in bulk seven and a half tons per million gallons treated.

HEALTH MATTERS.

Leprosy.

AT a recent meeting of the Epidemiological Society of London a paper was read by Dr. P. S. Abraham, on leprosy, of which the *Lancet* gives the following abstract. With the exception of the case recently brought forward in Dublin, no British society has lately had the subject under consideration. Its importance in British medicine is, nevertheless, well indicated by the fact that the Royal College of Physicians of London has its "leprosy committee," which, in view of the fact that there is increasing evidence respecting the communicability of leprosy, has just recommended a full and searching scientific investigation into the whole matter.

Dr. Abraham demonstrated on a map the wide prevalence of the disease, especially in the British Empire, and remarked that it is no wonder that the subject is coming to the front. He hoped that the inquiry urged by the College of Physicians would be sanctioned by the government, not only to set at rest, if possible, doubtful points regarding the causation of the disease and the desirability of preventive measures, but also to allay a possible emotional scare on the part of the British public. From the insufficiency of data it is difficult to say accurately whether leprosy be really increasing or decreasing in many of the British colonies. In many cases we have to rely chiefly upon general impressions. Even the death returns cannot be depended upon always, for they are frequently, as in Jamaica, uncertified by qualified practitioners; and we must remember the natural and universal tendency on the part of the sufferers and their friends to conceal their affliction. The belief in the increasing spread of leprosy at the Cape of Good Hope was so strong that a leprosy repression act was passed in 1884. From the numerous medical reports which Dr. Abraham quoted there can be little doubt that the disease is really on the increase in South Africa. It probably is spreading, but in a less marked manner, in the West Indies; and on the whole, in India, especially in certain districts.

The articles which are now appearing in the Anglo-Indian press indicate that the public mind is becoming somewhat inflamed over the matter; and that there is some cause may be inferred from the large amount of official attention which has been for some time past directed in India to the matter. Dr. Abraham quoted the late resolution (September, 1888) of the Indian government, stating that a measure of rigorous segregation would be repugnant to public opinion, and recommending for the present the grant of medicine and charitable relief in voluntary hospitals and asylums. A short history of leprosy in Hawaii was then given, the latest information having only just come to hand. He pointed out that, in spite of the efforts at isolation, the disease had enormously increased since 1865. The author gave an account of his visit last year to the Norwegian leper asylums, and gave particulars relating to the treatment of the patients, and the views with which he was favored by Drs. Danielssen, Nickoll, Kaurin, and Daud, who were in charge of the asylums at Bergen, Molde, and Trondhjem. He showed curves indicating the relations between the gradual decrease of the disease throughout the country and the number of patients in the hospitals.

With regard to leprosy in Great Britain and Ireland, he referred to cases he had recently seen in London. Through the kindness of Mr. Larder he was able to exhibit to the Society two fairly typical examples of the chief varieties of the disease, one the "nodular dermal form," and the other the so-called "anæsthetic" form. The latter case was that of a man sixty-four years old, a meat salesman, of English parentage, and born in London. When young he had been a sailor in the Mediterranean and in the Baltic, but had not been out of London for upwards of forty years. Until